I, the undersigned, who have prepared English translation which is attached herewith, hereby declare that the aforementioned translation is true and correct translation of officially certified copy of the Korean Patent Application No. 2002-58391 filed on September 26,2002.

This 10th day of October, 2005

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[SPECIFICATION]

[TITLE OF THE INVENTION]

PANELS FOR LIQUID CRYSTAL DISPLAYS AND A METHOD FOR MANUFACTURING THE SAME

[BRIEF DESCRIPTION OF THE DRAWINGS]

Fig. 1 is a plan view of a panel assembly for a display device according to an embodiment of the present invention;

Fig. 2 is a sectional view of the panel assembly shown in Fig. 1 taken along the line II-II';

Fig. 3 is a sectional view of a panel and a plurality of column spacers formed thereon for the display device according to an embodiment of the present invention;

Figs. 4A and 4B are sectional views of a panel assembly for the display device in intermediate steps of a manufacturing method thereof according to a first embodiment of the present invention;

Figs. 5A and 5B are sectional views of a panel assembly for the display device in intermediate steps of a manufacturing method thereof according to a second embodiment of the present invention;

Fig. 6 is a sectional view of a panel assembly for the display device in an intermediate step of a manufacturing method thereof according to a third embodiment of the present invention;

Fig. 7 is a layout view of an LCD according to the first embodiment of the present invention;

Fig. 8 is a sectional view of the LCD shown in Fig. 7 taken along the line VIII-VIII';

Fig. 9 is a sectional view of an LCD according to the second embodiment of the present invention; and

Fig. 10 shows exemplary locations of the spacers in the display device according to an embodiment of the present invention.

[DETAILED DESCRIPTION OF THE INVENTION]

[OBJECT OF THE INVENTION]

[FIELD OF THE INVENTION AND CONVENTIONAL ART IN THE FIELD]

The present invention relates to a panel for a liquid crystal display and a method for manufacturing the same, and in particular, to the panel for the liquid crystal display and the method for manufacturing the same including spacers.

Generally, a liquid crystal display (LCD) includes two panels including field-generating electrodes and coated with alignment layers and a liquid crystal (LC) layer having dielectric anisotropy and filled in a gap (called a cell gap) between the panels. Electric fields are applied to the LC layer by using field-generating electrodes and the transmittance of light passing through the panels are controlled by adjusting the field strength, thereby displaying desired picture images.

The two panels are assembled by printing a sealant along a periphery of one of the panels and by hot-pressing the panels.

The cell gap between the panels is supported by elastic spacers provided between the panels and the sealant also includes spacers for maintaining the cell gap. The LC layer is encapsulated by the sealant. The spacers include spherical spacers spread on the panels and columnar spacers formed by photolithography.

It becomes important to keep the cell gap uniform and to facilitate the formation of the LC layer as the LCD becomes large.

[TECHNICAL TASK OF THE INVENTION]

It is a motivation of the present invention to keep the cell gap uniform and to facilitate the formation of the LC layer.

[CONFIGURATION AND OPERATION OF THE INVENTION]

A panel assembly for a display device is provided, which includes: a panel; and a plurality of spacers formed on the panel for supporting the panel, wherein the spacers have at least two different heights or at least two different contact areas with the panel.

The contact areas of the spacers are circular or tetragonal.

The spacers preferably include a plurality of first spacers and a plurality of second spacers having a height lower than the first spacers and having a contact area wider than the first spacers.

The height difference between the first spacers and the second spacers is preferably in a range of about 0.3-0.6 microns, and the second spacers have a length larger than the first spacers preferably by 10-20 microns. It is preferable that the second spacers have a length in a range of about 30-35 microns and the first spacers have a length in a range of about 15-20 microns.

Preferably, a concentration of the second spacers is about 200-600/cm^2 and a concentration of the first spacer is about 250-450/cm^2.

The panel may include a gate line and a data line transmitting electrical signals such as scanning signal and image signal, a thin film transistor electrically connected to the gate line and the data line, and a pixel electrode connected to the thin film transistor. Alternatively, the panel includes a plurality of color filters of red, blue and green, which are sequentially formed.

According to an embodiment of the present invention, a method of manufacturing a liquid crystal panel assembly uses exposure mask of one sheet or two sheets.

According to a first embodiment of the present invention, a method of manufacturing a liquid crystal panel assembly is provided, which includes: coating a photoresist on a panel; light-exposing the photoresist through an exposure mask including an opening and disposed on the panel with a first distance; light-exposing the photoresist through the exposure mask disposed on the panel with a second distance; and developing the photoresist to form first and second spacers having different heights or different contact areas with the panel.

According to another embodiment of the present invention, a method of manufacturing a liquid crystal panel is provided, which includes: coating a photoresist on a panel; light-exposing the photoresist through a first exposure mask including a first opening; light-exposing the photoresist through a second exposure mask including a second opening; and developing the photoresist to form first and second spacers having different heights or different contact areas with the panel.

According to another embodiment of the present invention, a method of manufacturing a liquid crystal panel is provided, which includes: coating a photoresist on a panel; light-exposing the photoresist through an exposure mask including a plurality of transmissive areas having different transmittances and a blocking area; and developing the photoresist to form a plurality of spacers having different heights or different contact areas with the panel.

The photoresist is preferably a negative type.

The present invention now will be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. The present invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein.

In the drawings, the thickness of layers, films and regions are exaggerated for clarity. Like numerals refer to like elements throughout. It will be understood that when an element such as a layer, film, region or substrate is referred to as being "on" another element, it can be directly on the other element or intervening elements may also be present. In contrast, when an element is referred to as being "directly on" another element, there are no intervening elements present.

Now, panels for a liquid crystal display and manufacturing methods thereof according to embodiments of the present invention will be described with reference to the accompanying drawings.

In a method for manufacturing a display device including two panels, hot press process adhering the two panels to the plates, and pressing the two plates to attach two panels to each other, and vacuum compression process making the space enclosed by the sealant and two panels vacuous and exposing two panels to attach two panels to each other using the external atmosphere press are generally provided. Here, a plurality of spacers having the elasticity is arranged between the two panels to support the two panels with uniform interval, and the spacers may be spherical shape or column shape. The spherical spacers are dispersed on the panel and the column spacers are formed on the panel through a photolithography coating and pattering the photoresist. The column spacers may uniformly formed on the panel at the predetermined positions, and may wholly support two panels with uniform interval. Furthermore, the column spacers may uniformly support two panels with thin interval, and prevents the spacers from arranging in the pixel region so the characteristic of the display device is improved. The column spacers are pressed when the spacers supports two panels. However, if the sectional areas of the column spacers supporting the panels is small, and the compression deformation is large, the deformation of the column spacers are easily or the column spacers are breakdown, such that the cell gap between two panels is un-uniform. On the contrary, if the sectional areas of the column spacers supporting the panels is large, and the

compression deformation is small, it is difficult to adjust an amount of LC for forming the liquid crystal layer between two panels, such that the bubble is generated are the liquid crystal material is driven in the random position. To solve theses problems, the spacers have at least two different heights or at least two different contact areas with the panel in the present invention.

At first, a panel assembly for LCDs according to an embodiment of the present invention will be now described in detail with reference to the drawings.

Fig. 1 is a plan view of a panel assembly for LCDs according to an embodiment of the present invention and Fig. 2 is a sectional view of the panel assembly shown in Fig. 1 taken along the line II-II'.

As shown in Figs. 1 and 2, a panel assembly 120 according to an embodiment of the present invention includes two panels 110 and 120 and a plurality of LC layers 300, a plurality of sealants 500, and a plurality of columnar spacers 401 and 402, which are disposed between the two panels 110 and 120.

The panel assembly 120 includes a plurality of, for example, four cell areas divided by dotted lines A and B. The panel assembly 120 is separated into the respective LCDs by scribing the panel assembly 120 along the dotted lines A and B.

Each of the device areas (or an LCD) includes a display area 101, 102, 103 or 104 for displaying images. The display area 101-104 is substantially enclosed by the sealant 500, which confines the LC layer 300. The LC layer 300 may be formed after the panel assembly 120 is separated into the respective devices.

The spacers 401 and 402 are provided for maintaining a gap between the panels 110 and 120 to be uniform and the sealant 150 may contain spacers for supporting the panels 110 and 120 to be parallel to each other.

As shown in Fig. 2, the spacers 401 and 402 contact the panels 110 and 120 with different contact areas and sizes. The different contact areas of the spacers 401 and 402 are obtained by forming spacer columns with different heights and by pressing the spacer columns to have the same height, will be described in detail.

Fig. 3 is a sectional view of a panel and a plurality of column spacers formed thereon for an LCD according to an embodiment of the present invention.

A plurality of column spacers 401 and 402 having different top and/or bottom areas and different heights are formed on a panel 100 for an LCD according to an embodiment of the present invention. The first spacers 401 are shorter and wider than the second spacers 402 as shown in Fig. 3.

Top and bottom surfaces of the column spacers 401 and 402 have a shape of a circle with a diameter or a tetragon with edges. The diameter or edge (hereinafter referred to as "length") b of the bottom surface of each first spacer 401 is longer than the length c of each second spacer 402. The height difference a is preferably about 0.3 to 0.6 microns. It is preferable that the length b of the first spacers 401 ranges from about 30 microns to about 35 microns while the length c of the second spacers 402 is in a range between about 15-20 microns such that the length difference (b-c) ranges from about 10 microns to about 20 microns. It is also preferable that the bottom areas of the first and the second spacers 401 and 402 are in a range between about 600-1,100 square microns and in a range between about 150-350 square microns, respectively.

Since the first spacers 401 exhibit small compression deformation and are advantageous for dispersing the stress, they are capable of keeping a cell gap between the two panels 100 and 200 uniform. On the contrary, since the second spacers 402 exhibit large compression deformation, they facilitate to adjust an amount of LC for forming the liquid crystal layer 300.

Here, the first and the second spacers 401 and 402 are formed through the photolithography using one mask or two masks, and will be described with the reference of the drawings.

Figs. 4A and 4B are sectional views of a LC panel assembly in intermediate steps of a manufacturing method thereof according to a first embodiment of the present invention, Figs. 5A and 5B are sectional views of a panel assembly for the display device in intermediate steps of a manufacturing method thereof according to a second embodiment of the present invention, and Fig. 6 is a sectional view of a panel assembly for the display device in an intermediate step of a manufacturing method thereof according to a third embodiment of the present invention. The first and the third embodiments use one mask, and the second embodiment uses two mask.

Referring to Fig. 4A, a negative acrylic photoresist 400 is coated on a panel 100 for an LCD in the first embodiment. An exposure mask 600 including an opaque film 601 having a

plurality of openings 602 with a length e is disposed on the panel 100 with a distance d. The exposure mask 600 is aligned such that the openings 602 face portions of the photoresist 400 to become the second spacers 402 shown in Fig. 3. The photoresist 400 is then exposed to light from a light source through the exposure mask 600 so that the portions of the photoresist 400 exposed to light be hardened.

Referring to Fig. 4B, the exposure mask 600 is moved in horizontal and vertical directions such that it is spaced apart from the panel 10 by a distance ($d+\alpha$), where α is positive, and the openings 602 face portions of the photoresist 400 to become the first spacers 401 shown in Fig. 3. The photoresist 400 suffers light exposure through the exposure mask 600. Since the distance ($d+\alpha$) is larger than the distance d, the exposed portions of the photoresist 400 in this step have larger areas than those in the previous step due to the diffraction of light, and in addition, the intensity of the light reaching the photoresist 400 in this step is weaker than that in the previous step. Accordingly, the first spacers 401 become wider and shorter than the second spacers 402.

An experiment was successfully performed under the condition that a light source with luminance of 100-300 mJ/cm^2 was used, the diameter of the openings 602 was 10-15 microns, the distance d between the exposure mask 600 and the panel 100 was 100-200 microns, and the distance ($d+\alpha$) was 300-400 microns.

In the second embodiment, the step shown in Fig. 5A is similar to the step shown in the first embodiment. That is, after a negative acrylic photoresist 400 is coated on a LC panel 100, an exposure mask 600 including an opaque film 601 having a plurality of openings 602 with a length e is disposed on the panel 100 with a distance d and the photoresist 400 is then exposed to light from a light source through the exposure mask 600 so that portions of the photoresist 400 exposed to light are hardened to be the second spacers 402.

Referring to Fig. 5B, another exposure mask 700 including an opaque film 701 having a plurality of openings 702 with a length $e+\beta$, where β is positive, is disposed on the panel 100 such that the openings 702 face portions of the photoresist 400 to become the first spacers 401 shown in Fig. 3. The photoresist 400 is exposed to light from another light source with a luminance weaker than that of the light source used in the previous step.

Referring to Fig. 6, after a negative acrylic photoresist 400 is coated on a LC panel 100 in the third embodiment, an exposure mask 800 having a plurality of transparent areas, a

plurality of translucent areas, and an opaque area is disposed on the panel 100 with a distance. The opaque area and the translucent areas include an opaque film 801 and a plurality of translucent films 803, respectively, while the transparent areas have a plurality of openings 802. The exposure mask 800 is aligned such that the openings 802 and the translucent films 803 face portions of the photoresist 400 to become the second spacers 402 and the first spacers 401 shown in Fig. 3, respectively. The photoresist 400 is then exposed to light from a light source through the exposure mask 800.

The spacers 401 and 402 may be made from a positive photoresist, and in this case, the opaque areas and the transparent areas shown in Figs. 4A-6 are reversed.

The panel 100 may be a thin film transistor (TFT) array panel provided with a plurality of gate lines and a plurality of data lines for transmitting electrical signals such as scanning signals and data signals, a plurality of TFTs electrically connected to the gate lines and the data lines for controlling the data signals, and a plurality of pixel electrodes receiving the data voltages for driving the LC molecules.

The panels 100 may be provided with a common electrode facing the above-described pixel electrodes to generate electric fields for driving the LC molecules, and a plurality of color filters of red R, green G and blue B for color display.

The color filters or the common electrode may be formed on the TFT array panel.

An exemplary LC panel assembly according to an embodiment of the present invention will be described in more detail with reference to Figs. 7-9.

Fig. 7 is a layout view of an LCD according to a first embodiment of the present invention, Fig. 8 is an exemplary sectional view of the LCD shown in Fig. 7 taken along the line VIII-VIII', Fig. 9 is an exemplary sectional view of the LCD according to a second embodiment of the present invention, and Fig. 10 shows exemplary locations of the spacers in the display device according to an embodiment of the present invention.

The TFT array panel 100 is now described in detail.

A plurality of gate wires for transmitting gate signals and a plurality of storage electrode lines 13, which are made of conductive material having low resistance are formed on an insulating substrate 110.

The gate wires include the gate lines 121, a gate pad 125 connected to the gate lines 121 and applying scanning signal from the external to the gate lines 121 and a gate electrode 123

connected to the gate lines 121. But, the storage electrode lines 131 are added, the gate lines 121 may be extend to overlap the pixel electrode 190 such that expended potion of the gate lines 121 may make the storage capacitor along with the pixel electrode 190.

A gate insulating layer 140 preferably made of silicon nitride (SiNx) is formed on the gate wires 121, 123 and 125, and the storage electrode lines 131.

A plurality of semiconductor islands 150 preferably made of hydrogenated amorphous silicon (abbreviated as "a-Si") are formed on the gate insulating layer 140. The semiconductor islands 150 are located opposite the respective gate electrodes 123.

A plurality of ohmic contact islands 163 and 165 preferably made of silicide or n+ hydrogenated a-Si heavily doped with n type impurity are formed on the semiconductor islands 150.

A plurality of data wires separated from each other are formed on the ohmic contacts 163 and 165 and the gate insulating layer 140.

The data wires include a plurality of data lines 171 for transmitting data voltages extend substantially in the longitudinal direction and intersect the gate lines 121 and the storage electrode lines 131, a plurality of source electrode 173 toward the ohmic contact islands 163, a plurality of drain electrode 175 in a pair are separated from each other and opposite each other with respect to a gate electrode 123, and a plurality of data pads 179 connected to the data lines 171 and receiving the image signal form the external. The data wires further may include a plurality of storage conductor connected to the pixel electrode 190 and overlapping the storage electrode lines 131 to improve the storage capacitance.

A passivation layer 180 is formed on the data wires 171, 173, 175 and 179, and exposed portions of the semiconductor islands 150, which are not covered with the data lines 171 and the drain electrodes 175. The passivation layer 180 is preferably made of photosensitive organic material having a good flatness characteristic, low dielectric insulating material such as a-Si:C:O and a-Si:O:F formed by plasma enhanced chemical vapor deposition (PECVD), or inorganic material such as silicon nitride and silicon oxide. The passivation layer 180 may have a double-layered structure including a lower inorganic film and an upper organic film for preventing direct contact between the semiconductor islands 150 and an organic film.

The passivation layer 180 has a plurality of contact holes 189 and 185 exposing end portions 179 of the data lines 171 and the drain electrodes 175, respectively. The passivation

layer 180 and the gate insulating layer 140 have a plurality of contact holes 182 exposing end portions 125 of the gate lines 121.

A plurality of pixel electrodes 190 and a plurality of contact assistants 92 and 97, which are preferably made of ITO, IZO, are formed on the passivation layer 180.

The pixel electrodes 190 are physically and electrically connected to the drain electrodes 175 through the contact holes 185 such that the pixel electrodes 190 receive the data voltages from the drain electrodes 175.

The contact assistants 192 and 197 are connected to the gate pad 125 of the gate lines 121 and the data pad 179 of the data lines 171 through the contact holes 182 and 189, respectively.

Portions of the passivation layer 180 near the contact assistants 81 and 82 may be completely removed, and such a removal is particularly advantageous for a chip-on-glass type LCD.

The description of the common electrode panel 200 follows.

A black matrix 230 for preventing light leakage is formed on an insulating substrate 210 such as transparent glass and the black matrix 230 includes a plurality of openings facing the pixel regions and having substantially the same shape as the pixel electrodes 190.

A plurality of red, green and blue color filters 220 are formed substantially in the openings of the black matrix 230.

A common electrode 240 preferably made of transparent conductive material such as ITO and IZO is formed on the color filters 220 and the black matrix 230. The common electrode 240 covers entire surface of the panel 200.

A liquid crystal layer 300 is formed between the two panels, and a plurality of spacers 402 are formed between two panels 100 and 200 to support two panels 100 and 200 with the uniform interval. Although Figs. 7-9 show the second spacers 402 are showed, the first spacers (not shown) are actually formed.

The LCD may be a twisted nematic (TN) mode LCD where liquid crystal molecules in the liquid crystal layer 300 having positive dielectric anisotropy are aligned parallel to surfaces of the panels 100 and 200 and the molecular orientations are twisted from the surface of one of the panels 100 and 200 to the surface of the other of the panels 100 and 200 in absence of electric field. Alternatively, the LCD is a vertically aligned (VA) mode LCD, that is, the liquid crystal

molecules in the liquid crystal layer 300 with negative dielectric anisotropy are aligned vertical to surfaces of the panels 100 and 200 in absence of electric field. Alternatively, the LCD is an optically compensated bend (OCB) mode LCD, where the liquid crystal molecules have a bend alignment symmetrical with respect to a mid-plane between the panels 100 and 200 in absence of electric field.

Although the spacers 402 are formed on the thin film transistor array panel 100 in the first embodiment, may be formed on the common electrode panel 200.

Although Figs. 7-9 show the spacers 402 located on the data lines 171, the spacers 402 can be located on the gate lines 121, the TFTs, or any places covered by the black matrix 230.

Referring to Fig. 10, a plurality of red, green and blue color filters R, G and B are arranged in a stripe type. The spacers 401 and 402 are arranged in a regular or periodic manner along a row direction and a column direction. For example, the spacers 401 and 402 are located between the blue filters B and the red filters R and spaced apart from each other by predetermined transverse and longitudinal distances as shown in Fig. 10. The concentration of the first spacers 401 is preferably in a range of about 200-600/cm^2, while that of the second spacers 402 is preferably in a range of about 250-450/cm^2.

A method of manufacturing a panel assembly for an LCD according to the embodiment of the present invention is now described in detail.

At first, a plurality of gate wires, a plurality of data wires, a plurality of TFTs, a plurality of pixel electrodes and the like are formed on an insulating substrate 110 to form a TFT array panel 100. An organic insulating material is deposited on the panel 100 and patterned by photolithography to form a plurality of spacers 401 and 402 between the pixel areas. Meanwhile, a black matrix, a plurality of red, green and blue color filters, a common electrode, and so on are formed on another substrate 210 to form a common electrode panel 200. It is preferable that the size of the spacers 401 and 402 is equal to about 110-130% of the distance between the panels 100 and 200. The formation of the spacers 401 and 402 using photolithography enables to uniformly arrange the spacers 401 and 402 such that a thin uniform cell gap can be obtained throughout the panels 100 and 200 and the spacers 401 and 402 are prevented from being placed on the pixel regions, thereby improving the display characteristics.

Thereafter, a sealant 500 is coated on one of the panels 100 and 200 having the spacers 401 and 402. The sealant 500 has a shape of a closed loop without an injection hole for injecting

LC. The sealant 500 may be made of thermosetting material or ultraviolet-hardening material and may contain a plurality of spacers for keeping the gap between the panels 100 and 200. Since the sealant 500 has no injection hole, it is important to exactly control the amount of the LC material. In order to solve any problem due to the excessive amount of the LC or the insufficient amount of the LC, a buffer region without LC material even after the termination of the panel combination is preferably provided at the sealant 500. Meanwhile, it is preferable that the sealant 500 has an anti-reaction film on its surface, which is not reactant with the LC layer 300.

A LC material is coated or dropped using a LC coater on the one of the panels 100 and 200 coated with the sealant 500. The LC coater may have a dice shape such that it can drop the LC material at the LC device areas 101-104. The LC may be sprayed on the entire surface of the LC device areas 401-404. In this case, the LC coater has a shape of a sprayer.

The panels 100 and 200 are delivered to an assembly device with a vacuum chamber. The room surrounded by the panels 100 and 200 and the sealant 500 is evacuated and the panels 100 and 200 are closely adhered to each other using atmospheric pressure such that the distance between the panels 100 and 200 reaches a desired cell gap. The sealant 500 is completely hardened with the illumination of an ultra-violet (UV) ray using a light exposer. In this way, the two panels 100 and 200 are assembled to form a liquid crystal panel 120. The two panels 100 and 200 are exactly aligned to a minute order during the step of adhering the panels 100 and 200 and the step of illuminating UV ray on the sealant 150.

Finally, the liquid crystal panel 120 is separated into the LC device areas 101-104 using a scribing machine.

[ADVANTAGE OF THE INVENTION]

As described above, the spacers have at least two different heights or at least two different contact areas with the panel in the present invention. Accordingly, a cell gap between the two panels may be uniform, and may adjust an amount of LC for forming the liquid crystal layer.

[CLAIMS]

1. A panel for a liquid crystal display, the panel assembly comprising:

a panel; and

a plurality of spacers formed on the panel for supporting the panel,

wherein the spacers have at least two different heights or at least two different contact areas with the panel.

2. The panel of claim 1, wherein the contact areas of the spacers are circular or tetragonal.

3. The panel of claim 1, wherein the spacers comprise a plurality of first spacers and a plurality of second spacers having a height lower than the first spacers and having a contact area wider than the first spacers.

4. The panel of claim 3, wherein the height difference between the first spacers and the second spacers is in a range of about 0.3-0.6 microns.

5. The panel of claim 3, wherein the second spacers have a length larger than the first spacers by 10-20 microns.

6. The panel of claim 3, wherein the second spacers have a length in a range of about 30-35 microns and the first spacers have a length in a range of about 15-20 microns.

7. The panel of claim 3, wherein a concentration of the second spacers is about 200-600/cm^2 and a concentration of the first spacer is about 250-450/cm^2.

8. The panel of claim 1, wherein the panel comprises a gate wire and a data wire transmitting electrical signals, a thin film transistor electrically connected to the gate wire and the data wire, and a pixel electrode connected to the thin film transistor.

9. The panel of claim 1, wherein the panel comprises a plurality of color filters of red, green and blue.

10. A method of manufacturing a liquid crystal panel assembly, the method comprising:

coating a photoresist on a panel;

light-exposing the photoresist through an exposure mask including an opening and disposed on the panel with a first distance;

light-exposing the photoresist through the exposure mask disposed on the panel with a second distance; and

developing the photoresist to form first and second spacers having different heights or different contact areas with the panel.

11. A method of manufacturing a liquid crystal panel, the method comprising:

coating a photoresist on a panel;

light-exposing the photoresist through a first exposure mask including a first opening;

light-exposing the photoresist through a second exposure mask including a second opening; and

developing the photoresist to form first and second spacers having different heights or different contact areas with the panel.

12. A method of manufacturing a liquid crystal panel, the method comprising:

coating a photoresist on a panel;

light-exposing the photoresist through an exposure mask including a plurality of transmissive areas having different transmittances and a blocking area; and

developing the photoresist to form a plurality of spacers having different heights or different contact areas with the panel.

13. The method of one selected from claims 10 to 12, wherein the photoresist is a negative type.

[ABSTRACT OF THE DISCLOSURE]

[ABSTRACT]

A plurality of spacers is formed on a panel for a liquid crystal display for supporting the panel. The spacers have at least two different heights or at least two different contact areas with the panel. The spacers include a plurality of first spacers and a plurality of second spacers having a height lower than the first spacers and having a contact area wider than the first spacers. The height difference between the first spacers and the second spacers is preferably in a range of about 0.3-0.6 microns, and the second spacers have a length larger than the first spacers preferably by 10-20 microns. Since the first spacers exhibit small compression deformation and are advantageous for dispersing the stress, they are capable of keeping a cell gap between the two panels uniform. On the contrary, since the second spacers exhibit large compression deformation, they facilitate to adjust an amount of LC for forming the liquid crystal layer.

[REPRESENTATIVE FIGURE]

Fig. 3

[INDEX]

liquid crystal, spacer, liquid crystal panel, liquid crystal cell gap